National Park Service
U.S. Department of the Interior
San Francisco Bay Area Network
Inventory and Monitoring Program
Research Project Summary February 2009

Bat Inventory of Golden Gate National Recreation Area

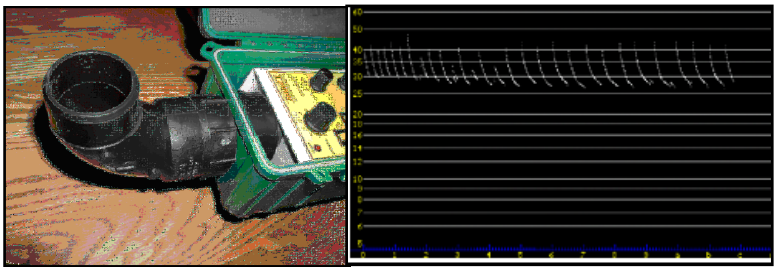
Importance: *Bats are both economically and ecologically important, providing ecosystem services such as predation of insects and pollination.*

Big brown bats are among at least eight bat species found in Golden Gate National Recreation Area.

Biodiversity of bats in the United States is relatively low (45 species) compared to other groups of organisms. California's central coast is known to support 17 species, nine of which have special status under state or federal law as they are believed to be at risk. Bats are nocturnal and use inaccessible roost sites, making them difficult to study in the wild. In general, bat populations are declining because of direct and indirect human impacts including destruction of foraging and roosting sites. Most species also have very low reproductive rates, resulting in long recovery periods after population declines. In addition, many populations are constrained by a limited number of specific roosting sites for a large number of individuals.

Inventory Methods: *Between July 2004 and July 2005, researchers detected bat vocalizations in Golden Gate National Recreation Area (GOGA) using Anabat bat detectors. The graph of each call can often be used to determine the species based on the frequency, call shape, call duration, and time intervals.*

The first long-term bat monitoring station in the National Park Service (NPS) San Francisco Bay Area Network was set up in December 1999 at Point Reyes National Seashore. Since then NPS has installed twelve additional stations including three in GOGA – one each at Fort Baker, Fort Funston, and Tennessee Valley. All sampling sites are on or near structures because of the need for 24-hour access to 110v power. Whenever possible, researchers placed bat monitoring stations near apparently good bat habitat and a source of water like a pond or small stream.



An Anabet bat detector inside a waterproof box and a sample vocalization of a big brown bat with the time between each call removed.

The Anabat bat detector records ultrasonic sounds, lowers them into a frequency range that can be heard by the human ear, and stores them as a graph on a computer. In most bat calls, each vocalization sweeps down in frequency (pitch). The slope of this sweep and the lowest frequency are important features that assist in identification of bat vocalizations. However, the characteristics of a call can change a great deal depending on a bat's actions. For example, an individual bat will tend to produce lower pitched calls that sweep through a small range of frequencies when the bat is flying in the open. If the bat flies through the more cluttered understory of a forest, the calls increase in pitch, tend to sweep through a wider range of frequencies, and occur more frequently. Calls also change when a bat detects a flying insect.

The variability in vocalizations within each species means that not all calls can be easily assigned to one species. As part of this inventory, researchers developed software to examine eight to ten features of each call and compare them to those of calls from known species of bats. Calls that are a close match were assigned to a particular species.

Table 1. Number of bat calls detected at each of the monitoring sites, July 2004 - July 2005. *Researchers do not know why the number of recordings of bats at Fort Baker declined between 2004 and 2005.

	Days in Operation	Calls Recorded
Ft Baker 2004	129	10,201*
Ft Baker 2005	189	1,765*
Ft Funston 2004	128	76,359
Ft Funston 2005	189	133,263
Tennessee Valley 2004	128	80,140
Tennessee Valley 2005	192	59,579
Totals	**955**	**361,307**

Inventory Findings: *A total of over 360,000 bat calls were recorded at the three GOGA monitoring sites, ranging from 12,000 at Ft. Baker to over 200,000 at Ft. Funston (Table 1). Researchers identified at least eight species of bats (Table 2).*

The difference in the numbers of calls recorded at the three different monitoring sites can likely be attributed to both the number of individual bats in the vicinity of the detector at each site and the activity of a few bats that might be foraging (flying back and forth) in the vicinity of the detector.

Table 2. Species of bats detected at each of the monitoring sites, July 2004 - July 2005. * symbol indicates Federal Species of Management Concern (insufficient information for listing under the Endangered Species Act).

	California or Yuma Myotis*	Little Brown Myotis	Fringed Myotis*	Big Brown Bat	Silver-haired Bat	Red Bat	Hoary Bat	Mexican Free-tailed bat
	Myotis yumanensis	*Myotis lucifugus*	*Myotis thysanodes*	*Eptesicus fuscus*	*Lasionycteris noctivagans*	*Lasiurus blossevillii*	*Lasiurus cinereus*	*Tadarida brasiliensis*
Fort Baker	N	Y	N	N	N	Y	Y	Y
Fort Funston	Y	Y	Y	Y	Y	Y	Y	Y
Tennessee Valley	Y	N	Y	Y	Y	Y	Y	Y

The red bat, hoary bat, and Mexican free-tailed bat were detected at all stations. Two of the most common bats in the San Francisco area (California myotis and Yuma myotis) cannot be distinguished acoustically, so they are lumped together. One moderately uncommon bat, the long-eared myotis (*Myotis eyotis*), that researchers have detected in other parts of the Bay Area was not detected in this study. Research results from ongoing bat monitoring in GOGA will be published in the future.

Additional Resources:

Fellers, Gary M. 2005. Acoustic Inventory and Monitoring of Bats at Golden Gate National Recreation Area Final Report. USGS Western Ecological Research Center. Prepared for NPS SFAN Inventory & Monitoring Program. Online: http://science.nature.nps.gov/im/units/sfan/Inventory/FinalInventoryReports/Progress_Report___Golden_Gate_NRA_September_2005.pdf.

Phase call, feeding buzzes, and social vocalizations can be played from the USGS Western Ecological Research Center website. Visit: http://www.werc.usgs.gov/bats/batstudiesnorth.html.

Bat species found at Muir Woods National Monument (part of GOGA) include all of those listed here with the exception of little brown myotis and with the addition of long-legged myotis and Townsend's big-eared bat.

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